II. EXECUTIVE SUMMARY

The college received NCATE accreditation and a Tier-II status (due to higher quality of entering students) among SUNY colleges. The number of students seeking an education in MST fields has gone up significantly. Curriculum changes have taken place earlier then expected, including approval of a combined BS/MS program in Computational Science in summer 2004. Future curriculum plans include creating a new track within the existing master’s program in Computational Science to address needs of MST teachers.

Within two years of this project, more than 20 college courses (undergraduate/graduate) in MST disciplines are now using CMST pedagogy and tools. The CMST Summer Institute has now been offered as a college course. The Summer Institute served more teachers than expected, including a total of 87 from the Rochester City, 9 from Brighton Central, and 5 from other local districts (Brockport, Greece, Kendall, LeRoy, East Ridge, and Corning). Overall, the CMST courses attracted more than 172 teachers to the college from 40 school districts in the region. The CMST faculty also served more than 200 RCSD and BCSD students through Interactive Physics Day (69), Interactive Physics Week (44), Team Challenge (35), Interactive Physics Challenge (50), and the Triathlon (42) Challenge.

The number of students in CMST-based courses (taught by Computational Science faculty) has gone from 44 in 2003 to 121 in 2004. A total of 92 summer- and 67 academic-year scholarships were awarded in 2004. Of 67 academic-year scholarships awarded to recruit teachers and students into CMST-based programs, about 21 were major-based to encourage pursuing a CMST-based formal degree in Computational Science and 46 were course-based to enrich education of MST students and teachers via a CMST course.

We are making considerable progress in answering the research question of this grant, which is to determine: 1) whether or not CMST works, and 2) if it does work, then how would it help the higher education and 7-12 schools improve their math and science education. This project’s dual role of ‘promoting CMST methodology and education’ and ‘improving teachers education through CMST’ is indeed making an impact on all partnering institutions and disciplines. The number of Brockport students in MST and Education disciplines went up considerably in 2004. This project, through its resources and efforts of its partnering school districts, has added more momentum and energy to a multi-year college initiative to increase quality and quantity of students. As summarized below, a similar trend of success can be seen in the two school districts in this partnership.
Rochester City and Brighton Central School Districts have been very supportive of the SCOLLARCITY partnership. The new Superintendent at RCSD (Dr. Rivera) has been very supportive through his new Strategic Plan, restructuring of the district in K-6 and 7-12 grades, and technology expansion in classrooms. Dr. Rivera visited the CMST Institute and participated in the graduation ceremony of more than 40 RCSD teachers from the CMST Institute in 2004. In his response to local newspapers, he attributed the success of district’s 39 percentage-point (ppt) increase in student achievement (NY State high school math exam) to district summer programs and teacher training efforts such as CMST. The district has now reached 90% passing rate in Regents math exam. There are also significant gains in the science area and also at middle school level, including an 8 ppt increase in State Grade 8 math exam over 2002-2003. Furthermore, target students (taught by CMST teachers) have outperformed others (control group) in almost all local state and exams. Target students outperformed control group in the 8th grade state math exam by 4 ppt; in the 8th grade state science exam by 8 ppt; and in Regents math exam by 3 ppt. There is a multitude of (institutional) changes at RCSD in support of math and science education, including a new strategic plan that puts professional development, instructional best practices, and access to technology among high priorities. CMST Co-Director from RCSD (Margaret Crowley) continued to play an excellent leadership role in her district to talk to teachers and encourage them to attend the CMST Institute, which so far has trained 87 teachers (more than 1/3rd of her district’s MST teachers). Jeff Mikols, a CMST Advanced teacher, has taken on a new role of mentoring district’s math teachers. If Jeff is judged by his testimony before the Congressional Science Committee, the district has made the right choice by having him incorporate CMST-based practices into RCSD’s professional development.

Brighton Central has played a major role in the success of this project. They have both gained from and also given back to the partnership. District data analysis of student achievement (target population versus control group) is delayed due to installation of a new system (SchoolTool), however, we can report based on data posted on NY State web site, that the district continues to do well with an 89% passing rate in State Grade 8 Math exam; an 11 ppt increase since 2002. The district has invested resources in support of this project and incorporated CMST experience into its district-wide changes in curriculum and information technology infrastructure. The district listens very well to the experience gained by its teachers in this partnership. In support of the project and in the form of an institutional change, the district gave laptops to all its MST teachers. It revised its curriculum maps and has now placed them on a web-based media with teachers having access to the curriculum and all related course materials electronically. Steve Whitman (CMST participant and instructor from Brighton) has reformed all of his physics labs using CMST tools (Interactive Physics) and he has been a champion of technology in education. As a strong sign of urban-suburban partnership, he has devoted countless hours to the education of students and teachers from the City through CMST Interactive Physics workshops. He also demonstrated to math and technology directors from the City District how the new curriculum map links to CMST tools at Brighton High School. Another science teacher, Ed Chi, whose testimony before the Congressional Science Committee was also eloquent and effective, has demonstrated use of graphing calculators in his classes to his students and colleagues. He is now offering CMST training to his colleagues through Brighton Teacher Center. Ed and Valerie Huff (math teacher from RCSD) have teamed up to participate (as invitees) in Supercomputing 2004.
Our Independent Evaluators, Linda Reid and Marion Arluckas, have been a source of great advice and research data for mid-course corrections. As before, the recruitment of teachers for the summer institute took a great deal of effort by all three partnering institutions. Applications were even received from teachers outside of the two partnering districts. Collaboration with a RETA partnership project (The Council of Chief State Schools Officers, American Research Institute, and Wisconsin Center for Education Research) helped us collect baseline data in April 2003 from all applicants (target group plus the control group) prior to our summer institute. This collaboration has provided us with evaluation instrumentation that could not have been created using our limited funds set aside for evaluation component.

The 2003 and 2004 Summer Institutes have been very successful. It took a great deal of teamwork to do it. We made mid-course corrections as we encountered problems, including registration of participants; space and air-conditioning issues; purchase of laptops, calculators, and software tools; cloning laptops and installation of software on college computer network; negotiations with vendors; organization of course materials, content of the course; management of office hours, weekly meetings by the Instructional Team; ceremonial gatherings, picnics, interviews with TV shows, Newspapers, and many other tasks. As reported by our Independent Evaluators in the next section on Quantitative Data, one hundred percent of participants rated the summer institute as a success. It was noted that this year’s beginner’s class performed much better than last year’s. According to Peter Veronesi, our Internal Evaluator and Science Educator, the structure of a beginner/advanced training enabled new teachers to learn from the advanced ones. More lesson plans were created this year, totaling more than 200 compared to last year’s 50. We are also improving our mentoring program through advanced-trained coaches, a full-time science outreach specialist in schools, and districts coaching directors (Jeff Mikols at RCSD and Steve Whitman at BCSD).

III. ACTIVITIES AND FINDINGS

(Report by the Independent Evaluators- Linda Reid and Marion Arluckas)

The second year goals of CMST Project have been to strengthen the SCOLLARCITY partnership between core partners (SUNY College at Brockport, Rochester City School District, and Brighton Central School District) and to continue implementing a professional development plan for grades 7-12 teachers and faculty to increase their awareness, knowledge and skills in CMST pedagogy. Project goals were also aimed at carrying out the plan for improving state mandated and nationally recognized learning and teaching preparation standards in science, math and technology through the use of the Computational Math Science and Technology (CMST) model.

The following accomplishments exceeded project goals. Some took place much earlier than their targeted timeframe due to hard work and collaboration. Others occurred due to the visionary role of the PI and strong leadership of the project team from the college and partnering school districts.

- **Student Achievement improved considerably** at Rochester City School District. The district average passing rate reached 90% in Regents math exam, a 39-point jump from June
2003. State-wide average is about 70%. Similarly, the district passing rate in state 8th grade math exam improved by 8 percentage points, from 11% (2003) to 19% (2004). State average is 51%. Students taught by project teachers (after one year participation) have also consistently outperformed others by 4 to 8 percentage points in most local and state exams in math and science.

- **PI and 2 CMST Teachers appeared before the Congressional Science Committee.** In their testimony, they presented results of CMST integrated approach to math and science and technology. The PI and two project teachers effectively demonstrated the CMST pedagogy to the Congressional audience using ‘Interactive Physics’ in science teaching. CMST teachers (Jeff Mikols-RCSD and Ed Chi-BCSD) reported on their experience from the field and cited early signs of a successful project. (See [http://www.house.gov/science/hearings/research03/](http://www.house.gov/science/hearings/research03/))

- **Number of teachers and amount of training exceeded expectations.** In summer 2004, the project trained 44 intro and 20 advanced level teachers, bringing the total of teachers receiving summer training so far to 101, which exceeded the project goal of 75. The duration of summer institute was also increased in 2004 from 4 weeks to 5 weeks. Through the advanced summer institute (NAS 601) and Saturday training sessions and new CMST courses, the targeted number of advanced-level teachers (25) were also met.

- **Offered additional in-service courses:** Dr. Ya_ar developed and offered a new graduate-level CMST course (Science, Technology, and Society) to 22 teachers in fall 2004. The majority of these teachers were from Greater Rochester and this outreach activity will be maintained in the coming years. Overall, the CMST courses attracted more than 172 teachers to the college from 40 school districts in the region.

- **NCATE accreditation:** The College obtained provisional NCATE accreditation earlier than its targeted date.

- **Monthly Saturday training was offered during the academic year.** In spring 2004, CMST offered a total of 3 sessions that attracted 50 teachers. Without these additional training sessions, there may not have been nearly as many Challenge Projects as submitted.

- **More students majoring or seeking certification in MST at Brockport.** The number of students enrolled in CMST courses taught by computational science faculty was more than doubled from 44 in fall ‘03 to 121 in fall ‘04. The number of students in other MST fields also increased significantly. CMST scholarships and promotional material played a role in terms of creating new courses such as NAS 401/501 and 601, and LST/CPS 725 and 726.

- **A total of 92 summer- and 67 academic-year tuition scholarships** were awarded in 2004 to RCSD/BCSD teachers and Brockport students. Of 67 scholarships awarded to recruit teachers and students into CMST-based programs, about 21 were major-based to encourage a CMST-based formal degree in Computational Science and 46 were course-based scholarships to enrich education of MST students via a CMST course. The increase in the number of students would not have been possible without joint efforts by both the college and school districts.

- **IHE faculty integrated CMST tools into more than 20 college courses,** including courses in math, science, and education. (See course list later). CMST faculties demonstrated perhaps the largest team-taught class in the College history. A total of 12 college faculty
from Brockport, 3 college faculty from outside institutions, and 7 specialists from national organizations taught a total of 64 teachers and 4 students in 2004 summer. This experimentation was also the largest peer-taught class: the 20 teachers in the advanced group also served as mentors/tutors/helpers for the 44 teachers in the beginners group.

- **Developed more than 200 CMST lesson plans** by college faculty and participating teachers over the project period. Access to teachers are given via web at www.cps.brockport.edu/cmst.

- **Published five (6) journal papers on CMST pedagogy.** Led mainly by the PI, team-produced and peer-reviewed articles appeared in J. IEEE Computing in Science and Engineering, J. SIAM Review, and Lecture Notes in Computer Science. Credit to NSF MSP program appears on the front page.

- **Summer Training was institutionalized as a college courses.** Both intro- and advanced-level summer training workshops have been registered as graduate level courses. Students in MST disciplines and in teacher preparation programs can have the training counted as part of their electives. The targeted date for this accomplishment was end of the 5-year grant.

- **Formal training was also offered during academic year.** The project offered intro-level summer course (NAS 501) during fall 2004 and trained 7 more participants. Extending the summer training course to academic year had not been targeted.

- **Training for Middle and High School Students:** Although the primary goal was to train teachers, the CMST Institute also held activities to reach out directly to students. The project reached more than 200 RCSD and BCSD students through Interactive Physics Day, Interactive Physics Week, the Challenge Competition, Interactive Physics Challenge, and the Triathlon Challenge. The one-day IP class involved about 69 students, 5 physics teachers (4 from RCSD and one from BCSD), and a Brockport faculty. The one-week IP training involved 44 students, two technology teachers and two guidance counselors from RCSD’s Educational Talent Search (ETS) program. ETS serves both motivated and ‘at-risk’ students. Students used IP to simulate motion of toys that they had built. Comparisons with experiments showed how CMST augmented their understanding. Dr. Little and Steve Whitman (BCSD) trained these RCSD teachers prior to the events, which took place in the college. Students were also introduced to Guidance Counselors at the College and were offered materials about higher education.

- **Joint Certification Training with TI.** Through substantial savings and partnership support from Texas Instruments, the CMST Institute offered a 9-days TI- certification (math) program to 24 teachers to local districts, including 14 teachers from the CMST advanced group. A similar certification program is planned in science for next year.

- **Combined BS/MS degree in Computational Science:** The approval by NY State Education department was obtained in summer 2004, much earlier than its targeted date (end of 5-year). The program will be used to attract more and better students to Brockport.

- **CMST Team was invited to Supercomputing 2004.** A team of two CMST teachers (Ed Chi from BCSD and Valerie Huff from RCSD) and two CMST faculties (Tahar and Van Voorst) were invited to attend the National Computational Science Workshop during Supercomputing 2004 Conference in Pittsburgh). Their travel expenses will be paid by the conference.
Helped promote overall quality at SUNY Brockport. Culminated by a multi-year drive for quality, the college attracted a higher caliber student body and was upgraded by SUNY from a Tier 3 ranking to a Tier 2 category. The option of offering a Computational Science program was a key factor in attracting students who scored high on SAT.

The following accomplishments met expectations targeted in the Strategic Plan and the 2nd year Implementation Plan:

- Implemented a 5-week summer institute, which provided training to 64 teachers as part of professional development. The institute included 6 Brockport students, two of which were offered a teaching job by BCSD as a result of such training. All participants received academic 3 credits.
- Tuition reimbursement was provided by Rochester City School District to MST teachers taking courses or seeking MS degrees to maintain their permanent certification.
- IBM laptops were provided by Brighton Central School District to all of its MST teachers
- IBM laptop computers were provided by the project to 44 new teachers and 5 instructional faculties. Also provided college-licensed education software tools and CMST-licensed new tools such as STELLA, AGENTSHEETS, and Interactive Physics. Added a new CMST tool (Geometer’s Sketch Pad (GSP)) to the training program.
- Texas Instruments TI-84+ graphing calculators were provided by the project to 64 teachers, 11 faculty members, and 4 teacher candidates during 2004 summer institute. TI also swapped (for free) TI-83+ calculators with TI-84+ for CMST participants from last year.
- Training was provided to 20 coaches who have been assigned to work with teachers from the summer institute during the school year. A schedule for bi-monthly meetings has been developed and distributed to the coaches.
- A List Server (ANGEL) has been set up for all CMST Participants, Faculty, Directors, PI and Evaluators. A web page for the CMST Project is active and serves as the technology link and direct access for all CMST Participants, Faculty, Directors, PI and Evaluators.
- Brighton Science Coordinator, Steve Whitman, has created a database of lesson plans and course materials using Interactive Physics. These lesson plans and IP examples have been hooked to a web-based curriculum map recently launched by the district. A link to this database will be put on the CMST web page.
- A database (EXAMgen) of questions aligned with NY State MST student learning outcomes was made available at RCSD by district administration in support of our Strategic Plan goals.
- First Year of Challenge program to serve students at grades 7-12 was a success. The program included a project-based competition and an exam-based competition (Triathlon). Ceremonies were held and trophies were given to teachers, students, and faculty who participated in these events. The impact on student achievement will be reported for the school year following the Challenge end-date (May 2004).
- Continued a mentoring program at Brighton Central and Rochester City school districts to offer professional development to participating teachers. Hired 20 coaches at two districts.
• Met with stakeholders to implement strategic plan of core partners for pedagogically improved courses at SUNY Brockport, RCSD, and BCSD.

• Modify curriculum maps at partnering school districts; Brighton School District completed Math and Science Curriculum Maps and has made them electronically available. The City School District curriculum and technology directors met with Brighton counterparts to learn from their experience.

• Participation in the MSP Learning Network to exchange results and expertise with other granted projects has been consistent since the inception of the project.

• Promoted CMST approach at several national conferences, including the International Conference on Computational Science (May 2004, Italy), the American Physics Society Conference (March 2004, Montreal), and the MSP Learning Network Meeting in January 2004 at Washington, D.C.

• Invited to participate in NSF NPACI Partnership meeting at NSF (Arlington, VA) in October 2003 to discuss promoting CMST approach to a national audience. Currently, developing a proposal with NPACI-EOT (www.eot.org) principals, to be submitted to NSF’s Cyber-infrastructure Program (CISE).

• CMST Faculty was invited to join an NIH grant proposal with Harvard Medical School to establish a Molecular Screening Center in Boston. Application of CMST tools to such research could yield interesting examples that might be incorporated into education.

• Promoted CMST Approach within the SUNY system. Through his membership and appointment in these SUNY-wide committees, the PI has promoted NSF’s MSP program and the CMST approach. He helped SUNY Senate and Research Foundation organize a Grants Workshop for 150 faculties.

• The PI served as Chair of an NSF MSP Panel in 2004. He was featured in major TV and newspapers in Turkey, which led to a successful faculty/students exchange program between Istanbul Technical University (ITU) and SUNY. The PI is investigating math and science education in Turkey in hopes of extracting lessons for the SCOLLARCITY partnership. An agreement was signed by Chancellor King between SUNY and ITU to exchange students.

• News Releases and TV interviews were granted to local media during the opening ceremony of the CMST Institute and graduation. Occasional news releases are also being published in the Democrat and Chronicle, Brockport Post, and Brighton-Pittsford Post.